Light and Lighting

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Examinations in Illuminating Engineering

AS we reach the end of another year the opportunity is taken to remind readers of the Examinations in Illuminating Engineering, instituted by the City and Guilds Institute, which are normally held in May each year and for which entries should be received before March next.

These examinations—the only existing examinational standard in illuminating engineering—offer a valuable opportunity of gaining distinction, and serve as one of the qualifications for Fellowship in the Illuminating Engineering Society.

Students can readily enter through colleges with which they are associated, but many of those who hold positions in the lighting industry should also be equal to taking the examinations.

Full particulars of these examinations, including specimen questions for the Intermediate and Final Grades, are given in a pamphlet issued by the I.E.S., by whom copies of this leaflet will be sent on request.

"Daylight Illumination in Factories and Workshops"

We have been favoured with a copy of the "Journal of the Junior Institution of Engineers" (December, 1943) containing a recent address given by Mr. P. J. Waldram to the Institution on the above subject. It is interesting to recall that Mr. Waldram was chairman of this body, of which he is now vice-president, fifty years ago. The subject is a very timely one, and the paper deals with it very fully, explaining at length methods of daylight measurement and devices for the prediction of daylight illumination in buildings under specified conditions. Members of the Illuminating Engineering Society may be interested to learn that copies of this address are being reprinted (we understand at a cost of 1s. 6d. each) by the Junior Institution of Engineers (39, Victoria-street, London, S.W.1), to whom application for copies should be made.

The Standard Voltage

Our recent reference to the adoption of 230 volts as the sole standard has caught the eye of Mr. A. P. Trotter, who sends us an extract from his reminiscences. People are apt to imagine that a conference in the early days might have saved all the subsequent trouble and expense in converting to the present standard. It should be remembered, however, that early efforts were linked with problems of lamp production. Swan began by making carbon lamps for use with 20 Bunsen cells, and in the period before 1888 lamps of 50 volts were used for domestic lighting. The economic advantages of higher presures were, however, afterwards recognised, 60, 85, and 100 volts being adopted and lamps made to suit. Afterwards the introduction of Dr. John Hopkinson's three-wire system induced lamp-makers to produce 200 and 220 volt lamps—at first with a rather poor life. (It is recorded that one consulting engineer advised a town to use lamps for 115 volts—since these "throw-outs" could be bought at a low price from the makers!) 250 volts was subsequently fixed by the Board of Trade as the highest permissible "low pressure," and still later 230 volts became the recognised standard.

"The Poetry of Light"

We learn with interest that the address on the above subject by Mr. R. Gillespie Williams before the I.E.S. Birmingham Centre on December 10 proved very successful. There was an audience of nearly two hundred. The Lord Mayor of Birmingham was present, and also Sir Barry Jackson, who proposed a vote of thanks to the author. This address, which is accompanied by attractive demonstrations, has been given four times during the past session, and on each occasion has proved very popular. Perhaps, therefore, an opportunity may be found for this event to be repeated in London in the future.

Forthcoming I.E.S. Meetings

(Provisional List)

SESSIONAL MEETINGS IN LONDON

1944.

Jan. 18th. Addresses on **The Place of Science in the Art of Lighting,** by MR. ALISTER MACDONALD, F.R.I.B.A. (Chairman, Architectural Science Board), and MR. R. O. ACKERLEY, F.I.E.S. (The chair will be taken by Mr. Percy Thomas, President, R.I.B.A.) *(Joint Meeting with the Royal Institute of British Architects, to be held at the R.I.B.A., 66, Portland Place, London, W.1.)* **5.30 p.m.**

Feb. 14th. Address by THE PRESIDENT (DR. H. BUCKLEY) on **18th Century Contributions to Photometry and Illuminating Engineering.** *(Sessional Meeting to be held at The Royal Institution, Albemarle Street, London, W.1.)* **5 p.m.**

MEETINGS OF CENTRES AND GROUPS

1944.

Jan. 5th. A Series of Short Papers. *(Meeting of the Newcastle Centre, to be held at the Minor Hall, Oxford Street, Newcastle-on-Tyne.)* **5.30 p.m.**

Jan. 10th. Paper by a Gas Engineer. *(Meeting of the Cardiff Centre, to be held in the Cardiff Corporation Demonstration Theatre, The Hayes, Cardiff.)* **3 p.m.**

Jan. 13th. DR. W. D. WRIGHT on **Colour Problems in Illuminating Engineering.** *(Meeting of the Manchester Centre, to be held in the Reynolds Hall, College of Technology, Sackville Street, Manchester.)* **2.30 p.m.**

Jan. 13th. MR. J. W. HOWELL on **Lighting in the Bleaching, Dyeing, Printing and Finishing Industries.** *(Meeting of the Bradford Group, to be held in Bradford Electricity Department Showrooms, Sunbridge Road, Bradford.)* **6.45 p.m.**

Jan. 17th. MR. W. R. STEVENS on **The Application of Low Pressure Fluorescent Lamps.** *(Meeting of the Bath and Bristol Centre, to be held at the Grand Hotel, Broad Street, Bristol.)* **7 p.m.**

Jan. 21st. MR. W. J. G. DAVEY on **Post War Street Lighting.** *(Meeting of the Glasgow Centre, to be held in the "Cadoro" Restaurant, Glasgow.)* **6 p.m.**

1944.

Jan. 28th. MR. J. ASHMORE on **Electric Lighting. A Contractor's Viewpoint.** *(Meeting of the Birmingham Centre, to be held at the Imperial Hotel, Temple Street, Birmingham.)* **6 p.m.**

Feb. 1st. MR. A. L. RANDALL on **Electric Discharge Lighting.** *(Meeting of the Derby Group, to be held in the Borough of Derby Electricity Showrooms, Irongate, Derby.)* **6 p.m.**

Feb. 2nd. MR. E. C. LENNOX on **Post-War Street Lighting.** *(Meeting of the Newcastle Centre, to be held in the Minor Hall, Oxford Street, Newcastle-on-Tyne.)* **5.30 p.m.**

Feb. 4th. MR. S. G. TURNER on **Progress of Lighting in Industry.** *(Joint Meeting of the Cardiff Centre with the South Wales Institution of Engineers, at Neath.)* **3 p.m.**

Feb. 7th. MR. E. J. IRELAND on **Foot Candles, Lumens and All That.** *(Meeting of the Bath and Bristol Centre, to be held in the Pump Rooms, Bath.)* **7 p.m.**

Feb. 7th. MR. J. W. HOWELL on **Lighting in the Dyeing, Bleaching and Finishing Industry.** *(Meeting of the Leeds Centre, to be held in the Leeds Corporation Electricity Showrooms, The Headrow, Leeds.)* **5.15 p.m.**

Feb. 7th. DR. S. ENGLISH on **The Precise Control of Light by Glassware.** *(Meeting of the Sheffield Centre, to be held in the Central Library, Tudor Place, Sheffield.)* **6 p.m.**

Feb. 10th. MR. W. BROWNING on **Reflections** and MR. ALAN H. OWEN on **Home Lighting and Decoration.** *(Meeting of the Manchester Centre, to be held in the Reynolds Hall, College of Technology, Sackville Street, Manchester.)* **2.30 p.m.**

Feb. 10th. DR. W. J. WELLWOOD FERGUSON on **The Eye.** *(Meeting of the Bradford Group, to be held in the Bradford Electricity Department Showrooms, Sunbridge Road, Bradford.)* **6.45 p.m.**

Feb. 18th. Address by THE PRESIDENT (DR. H. BUCKLEY). *(Meeting of the Glasgow Centre, to be held in the "Cadoro" Restaurant, Glasgow.)* **6 p.m.**

Feb. 25th. Short Papers forming a **Symposium on Lighting.** *(Meeting of the Birmingham Centre, to be held at the Imperial Hotel, Temple Street, Birmingham.)* **6 p.m.**

(Secretaries of Centres and Groups are requested to send in particulars of meetings in advance, mentioning subject, author, place, date and time of meeting.)

Future Standard Specifications for Street Lighting

In what follows we give a summary of the proceedings at the Joint Meeting of the Illuminating Engineering Society and the Association of Public Lighting Engineers, held in London on December 14, 1943

It will be recalled that the final report of the Committee formed by the Ministry of Transport to investigate street lighting was issued in 1937, and it visualised the preparation of a British Standard Specification which would serve as a guide to those concerned with the application of the Report. Much effort was then expended on the framing of a suitable specification, but the B.S.I. Committee evidently found it rather "heavy going," and the issue of the specification was still being awaited when war broke out.

The Post-War Period.

During the post-war period a new start will have to be made, and the discussion arranged by the Illuminating Engineering Society on December 14 was therefore a timely one. The full title of the discussion—"Street Lighting Specifications for Street Lighting: Should they be based on the Design of the Unit or the Effect of the Illumination?"—offered good scope to the two opening speakers, Dr. S. English and Mr. R. Maxted. The President, in opening the meeting, expressed appreciation of this opportunity of co-operation with the Association of Public Lighting Engineers, whose president, Mr. E. J. Stewart, was also on the platform. He also called for a clear understanding that no one—and particularly neither of the two opening speakers—was to be called to task in the future for the views expressed on this occasion!

Street Lighting or Lanterns?

Dr. English opened his contribution by going to the root of the matter. Is it street lighting we wish to specify or is it lanterns? It had been contended that the characteristics of street lighting were so complex that they were unspecifiable. It might also be argued that for war time street lighting it had been found best to specify the performance of lanterns and that this practice might well be followed in the future.

War Measures No Guide to the Future.

In reply to this latter argument Dr. English suggested that it was illogical to assume that what was found convenient in war time was also expedient under normal conditions. There were special considerations during war time, e.g., the very low order of illumination which could not be measured readily (0.0002 ft.c.), the obligation not to exceed the permissible value, and the desirability (absent in peace time!) of compelling strict adherence to certain imposed conditions. The very much higher values of illumination which we hope to see after the war should make measurement in the street relatively easy, and there should be scope for freedom in design. In any case polar curves of light distribution were notoriously difficult to interpret, even by lighting engineers—and still more so by laymen.

New Basis of Illumination Measurement.

It was true, Dr. English proceeded, that the 1931 specification had drawbacks, but this had the weakness of measuring illumination at one particular spot, the "test point," and ignored the distribution of light in other parts of the road. As a safeguard against "pools of darkness" measurements of road brightness

had been suggested, but such measurements are admittedly difficult and extraneous factors, such as the nature of the surface and the weather, materially affect results.

In order to ensure reasonably good visibility it would probably be necessary only to take measurements of illumination at, say, five specified points and to prescribe the ratio max./min. illumination, and Dr. English presented several tables and diagrams showing how this might effectively be done.

Specifications and Codes of Practice.

Mr. R. Maxted's view of what is necessary contemplated codes of practice with correlated street lantern specifications. The former preserves the essentials of a successful technique in applying equipment, the latter secures the supply of equipment having proven virtues. Codes and specifications should not, however, by too arbitrary treatment, frustrate skilful design and future development. Mr. Maxted pointed out how great was the progress achieved in pre-war years without detailed specification; for instance, much had been done towards devising measures of securing good visibility, although one could not define this term with precision. The objects of the user and the designer are different. The user should satisfy himself that the *effect* is what he needs, but it is the lighting engineer's province to take the technical measures to secure these results, and the codes and specification should serve mainly for benefit and guidance.

Lantern Specifications a Necessity.

Mr. Maxted contended that a lantern specification was a natural statement of underlying principles, and remarked that most installation designers did in fact frame informal lantern specifications for their own guidance. He quoted Mr. Percy Good to the effect that specifications dealing with buying and selling a commodity were, with advantage, measurable in the test room or laboratory. He then proceeded to make detailed suggestions in regard to the limitation of the polar curve to secure desirable conditions in practice.

A General Scheme.

In the concluding portion of his address he made suggestions for (1) the Photometric Contents of a Lantern Specification, (2) Codes of Practice for Traffic Routes [(i.) Siting, and (ii.) Backgrounds], and (3) a Scheme of Codes and Specifications involving (a) a General Code, covering broad technical policy, and (b) series of codes of practice, each applying to a specific system of lighting and tied to a corresponding lantern specification.

Besides the photometric characteristics (boundaries of polar curves, luminous output, etc.), the lantern performance under specified conditions should be defined, based on laboratory tests, and the brightness of the unit and maintenance of performance in practice should receive some attention. The general scheme of codes and specification should be of a very embracing character, not overlooking such points as classification of streets and highways, guidance on amenities, and provision for development trials.

The discussion was taken up by Mr. E. J. Stewart and Mr. T. Wilkie, as public lighting engineers, and a number of others took part. As was perhaps to be expected, the comments were of a somewhat general nature and, without giving any very clear indication of policy, illustrated and amplified points made in the introductory addresses.

The complete contributions and the ensuing discussion will appear in the I.E.S. "Transactions" in due course.

Lighting in the Post-war Period

Mr. F. C. Smith's address to the I.E.S. Bath-Bristol Centre on November 1 was very well received, and certainly covered a wide ground, dealing both with natural and artificial lighting and reviewing, in turn, the lighting of dwellings, offices, and factories, schools and streets.

Mr. Smith suggested that the average citizen, if appealed to, would probably insist that post-war houses should be "light and airy." Much importance attaches to the admission of daylight. The lecturer spent some time in explaining the "daylight factor" and the conception of the "no skyline" in interiors, and in recalling suggested standards, such as the minimum of 0.2 per cent. daylight factor approved by the I.C.I. before the war. This led to suggestions for the design of buildings and the planning of cities. The problem is, however, complicated by other considerations, such as ventilation, heating, and provision of sound insulation—all factors influenced by the extent of the window space.

Mr. Smith pointed out that the resources of the nation were necessarily concentrated on war work, so that any sudden influx of post-war inventions was unlikely. In this country only the 80-watt fluorescent lamps were so far available, and in limited quantities, but their qualities should lead to their wide adoption. Before the war researches by the gas industry gave promise of modified burners, working at ordinary district pressures but at efficiencies approaching those previously attained only with high-pressure lamps.

Remarking on the unsatisfactory lighting in the homes of the people, Mr. Smith mentioned the belief that their weekly budget would not permit of really adequate lighting. Lack of knowledge on what really constituted good lighting might be another explanation. Quotations from the I.E.S. Code were given, and the selection of well-designed fittings, their use in appropriate positions, and the needs of different types of rooms being discussed in turn.

For schools of the future, the lecturer suggested, wherever possible single-storey buildings would be adopted. Artificial lighting would be affected by the ceiling height, which might not exceed 11 ft., for levels of illumination would probably be higher than in the past. The conditions desirable in classrooms, laboratories, workshops, etc., were briefly reviewed.

Recalling that adequate and suitable lighting was now demanded in factories, Mr. Smith pointed out, as an anomaly, that there was no similar legal requirement in *offices*.

Mr. Smith devoted considerable attention to post-war public lighting, pointing out the variations in the problem to be faced by different authorities, according to the amount of devastation suffered. In addition to administration problems, there was the difficulty that there is as yet no single "yardstick" by which the excellence of installations can be measured. He put in a plea for dignified floodlighting, the avoidance of disfiguring signs, and the preservation of public amenities.

Reviews of Books

Handbook of British Standards (*B.S. Handbook, No.* 1, 1943, *issued by the British Standards Institution, London*, 1943; *pp.* 152. 1*s.* 6*d. post free*).

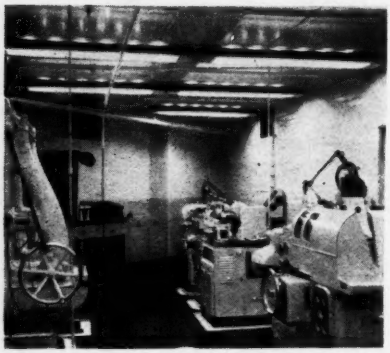
This handbook presents a wonderful record of service. In the Annual Report it is mentioned that there are now 2,800 contributing members and some 8,500 members serving on B.S.I. Committees. In all, 1,500 British Standards have been issued (including 230 new issues, revisions, and amendments presented during the past year). This Report reviews briefly the work of the main industry committees dealing with building, chemical engineering, and textile operations, etc. It is followed by a list of new and revised standards in course of preparation and by the complete numerical list of British Standards, occupying thirty-five pages. Finally there is a very comprehensive subject index.

Use of Light Finishes on Machine Tools

By J. H. Nelson

In order to get the full benefit of a modern lighting installation, especially with the new 5-ft. fluorescent tube, the decoration of the shop and the colour of the machine tools themselves must be given careful consideration.

Reports from America (1) of the use of very light finishes in the workshop have led to experiments in this country. The picture shows such an experimental installation, which has been done as part of a thorough investigation into the effects of decoration on the seeing conditions in industry. The machines in this small section of the tool-room of a large midland factory have been painted a "Portland Stone" (2) while the walls



Courtesy: Joseph Lucas, Ltd.

Tool-room Lighting and Decoration.

have been pained "Eau de Nil" below the dado and "Pale Cream" above. The ceiling is white.

The pleasantness of the shop is evident from the photograph, though the full effect cannot be reproduced without colour. The sense of lightness is obtained with a relatively low level of illumination, 15 ft.c. at the working plane, a value rather low for the class of work being carried out. This illumination is, however, sufficient for use with the particular machine as their construction renders local lighting almost essential.

The even distribution of illumination and the resulting relatively high brightness of all painted surfaces make it particularly easy to read and set dials accurately—a factor of consequence in a tool-room, where accuracy is all important.

A dark green skirting round the walls and machines, combined with a neat drip tray and a white line, gives a finishing touch to the neatness of the shop, and serves to protect the wall surface when the floor is scrubbed.

(1) A. A. Brainerd and M. Denning, Illum. Eng. 36, 1,379 (1941).
(2) B.S.S., No. 341 (1930), Portland Stone, No. 64; Pale Cream, No. 52; Eau de Nil, No. 16.

Lighting a Large Assembly Shop

The accompanying photograph shows the effect of a new installation in a large assembly shop. 26 "Philora" 400-W fluorescent lamps in Verity's angle type reflectors are mounted on either side of the shop at a height of 16 ft. These units are supplemented by 16 similar lamps in concentrating reflectors, mounted on the roof trusses 45 ft. high.

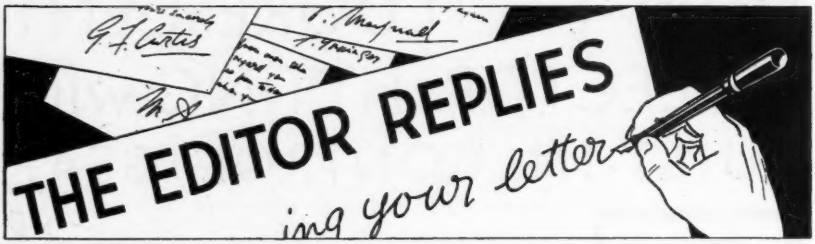
The original tungsten installation consisted of 36 1,000-W tungsten lamps

in dispersive reflectors, all mounted on the roof trusses.

As a result the illumination has been increased from 6 to 12-15 ft.c. and yet the total consumption is now only 12.8 kW as compared with 36 kW for the old installation.

An increase in production and a lessening of fatigue on the part of the workers have also been noted.

These results indicate the importance of assigning the best possible positions to light sources, as well as selecting the most efficient lighting equipment.



I believe there has been some suggestion that **a code of natural lighting,** supplementary to the familiar I.E.S. code of artificial lighting, should be available. A main feature would presumably be the specification of daylight factors, possibly also the proportion of space in certain types of interiors over which a certain minimum daylight factor should prevail.

By the time such a code emerges something may perhaps have been done to remedy one evident weakness in the present (artificial lighting) code—the absence of detailed guidance in regard to **quality of lighting.** It is often said that the lighting industry—even now—is far too prone to think in terms of foot-candles alone. Similarly, in regard to natural lighting, it is too readily assumed that the sole aim is to get a good daylight factor, i.e., the maximum entrance of daylight into the interior studied.

Natural lighting, and especially natural lighting found in rooms, **is not automatically perfect** as regards quality. Most of us experience from time to time glare from windows demanding the alleviation of blinds. Even when definite glare is absent conditions of contrast may be detrimental to good seeing—as one is conscious when the features of the chairman of a committee, seated with his back to the window, become indistinguishable. Positions of windows are of some moment in relation to the purposes served by rooms, and a well selected scheme of decoration for walls and ceiling is possibly even more important than for artificial lighting.

Whilst referring to this subject, I take the opportunity of referring to the impression that one sometimes hears expressed—even in the present stage of illuminating engineering—that **codes and standards** are harmful in **restricting progress.** I hold that—always provided that recommendations are subject to judicious revision at intervals—the exact contrary is the case.

Complaint is occasionally made by those who consider the values in the code excessive and burdensome. But objection may also rest on precisely opposite grounds—the deification of foot-candles and the belief that in certain areas values much higher than those prescribed in the code prevail. It should be recognised that a code, in order to be acceptable, should prescribe **"good modern practice"**—it should never be keyed up to the very

highest values now being installed. Furthermore, statutory regulations, on which penalties may be based, will necessarily state values lower than "good modern practice." Yet both are of signal value—to the lighting industry as well as the public.

Present conditions are exceptional. Whether manufacturers will be willing to spend as generously on lighting after the war remains to be seen. Yet it will probably still be true that the largest, wealthiest, and most enterprising firms will spend even more than the code requires. For them a code is not needed—**it is for the rank and file of factories,** still the great majority—whom the Factory Department, for years before the war, were endeavouring to "bring up to scratch." Sir John Parsons, himself a member of the Departmental Committee on Lighting in Factories, emphasised, in his recent address, how fortunate it was that the **I.E.S. Code was there,** ready, at the outbreak of war.

As regards the general expediency or otherwise of regulations, codes of practice, etc., I have myself no doubt that it is in the interests of good lighting to secure them whenever the interests of the community are served—in streets, factories, offices, schools, and even (with certain reservations) in dwellings. It is worth almost any sacrifice to get **good lighting recognised** in law—and the future status of the illuminating engineer depends in no small measure on this being done.

There are naturally some repercussions of the recent discussion on **post-war street lighting,** especially from those who are reluctant to discard possibilities of post-war lighting from searchlights, captive balloons, etc.

"In defence of the moon" it has been pointed out that although, theoretically, moonlight is open to the objection that much of it falls on the roofs of buildings and only a portion (sometimes a small portion) on pavements and roadways, yet in actual fact, as we have discovered during the war, moonlight is extremely valuable. The immense difference in the appearance of streets is at once evident when the moon rises—even though its rays strike the earth at an extreme obliquity so that buildings obstruct most of the direct light. One reason, doubtless, is that almost invariably light is scattered by the atmosphere, from which some degree of mist is rarely absent.

There is no gainsaying the fact that the effect of moonlight thus diffused is very good, comparing favourably with ordinary street lighting in several important respects, e.g., absence of glare, uniformity of illumination, and the fact that a surface of uniform brightness is presented overhead, reflection of which in more or less shiny surfaces may create an impression of very even road surface brightness. It remains to be seen, however, whether one could economically imitate this effect artificially. It must also be considered that **the level of illumination** (probably of the order of **0.001 ft.c.**) is far lower than that customary in artificially lighted streets, and only impresses us in present circumstances because our

standard of comparison is complete obscurity!

For another view that has been urged on me in connection with the future of public lighting there is, I think, more to be said. In the pre-war period efforts were perhaps necessarily concentrated mainly on the lighting of traffic highways. This may remain a major problem. Yet anyone who has studied post-war planning schemes—such as that promoted by the L.C.C.—must have observed the deliberate allocation of space to **squares, open places, and parks and gardens,** of which, presumably, the public will be encouraged to make use by night. The lighting of such areas does, surely, deserve study, and they can scarcely be catered for by specifications primarily designed to produce "ribbons of light" for the guidance of high-speed motor traffic.

Statistics of **road fatalities** continue to show an improving tendency. In the month of September both the total of fatal road accidents and the number occurring during darkness showed a reduction. Moreover, the "test ratio," i.e., the ratio of accidents occurring in daylight to those experienced during darkness now shows a definite reduction roughly, from 1 : 4 to 1 : 3.5. Many causes could be assigned, but probably the most potent is the gradual adaptation of the public to the abnormal conditions.

My attention has been drawn to a statement that the use of an orange filter has been found beneficial for **lighting chart-rooms on vessels at sea.** Experiments are said to have shown that by using light of this colour the period of adaptation, when the observer moves from the lighted chart-room into the surrounding darkness, is reduced. (Red light would be even better, but this is inadmissible because so many corrections on charts are executed in red ink.) I see nothing improbable in this conclusion. In the dark-adapted eye the central region, the fovea, is almost inoperative and vision is effected mainly by the peripheral region. It is, however, mainly the fovea that is sensitive to the red and orange end of the spectrum, whereas the peripheral region is mainly influenced by blue and violet light. The exclusion of this part of the spectrum, therefore, should leave this peripheral region relatively unaffected.

A recent conversation afforded me an opportunity of raising a point on which I have not infrequently received inquiries—the object of the special design of so-called **"scialitic" lamps** for **lighting operating tables in hospitals.**

Such lamps utilise somewhat elaborate systems of mirrors and lenses. I have heard it suggested that such complexities are unnecessary, and that umbrella-like indirect units with a white diffusing reflecting surface would furnish a "shadowless" light and do equally well. It must be remembered, however, that the object is to secure not only a **shadowless** but also a **highly concentrated light.** Some hundreds of foot-candles on the operating table are considered desirable, and this value could hardly be achieved from diffusing surfaces which simply scatter the light.

Fluorescent Lighting in Factory and Drawing Office

Fig. 1. A general view of the Erecting Shop, where 8-9 ft.c. is provided; a higher illumination up to 30 ft.c. is furnished by additional fittings over the bench and machines in the centre of the room.

The factory here illustrated is now almost entirely devoted to the production of essential war material. Lighting with Sieray fluorescent tubes was prepared by the Illuminating Engineering Department of Siemens Electric Lamps and Supplies, Ltd., and was subsequently installed by Powerlite Electrical Installations, Ltd.

This mode of lighting has given excellent results in the erecting shop (Fig. 1) and in the machine shop, the lamps being so arranged as to give extra illumination, which is superimposed over the general illumination throughout the interior, at places where it is mainly needed.

Of special interest is the effect in the drawing office (Fig. 2), where trough reflectors were mounted diagonally across the lines of drawing boards.

The load for this installation is only 0.84 kW per sq. ft., and in some cases is actually less than originally, when tungsten filament lamps were in use.

Fig. 2. A view of the Drawing Office, where an average illumination of 15-16 ft.c. is provided. The picture illustrates the "shadowless" nature of the lighting — no apparent shadow being cast by the draughtsman's pencil.

Colour Measurement in Paper Making

A paper on this subject by Mr. S. R. H. Edge and Miss H. M. McKenzie was read at the fourteenth meeting of the Colour Group, held jointly with the technical section of the Paper Makers' Association, at the E.L.M.A. Lighting Service Bureau on November 10. The paper was largely concerned with the authors' experience in the use of the Blancometer during the eleven years since that instrument was first described. It is, in essence, a photoelectric colorimeter designed especially to measure colour differences between a standard surface and a test surface. In the case of near-whites, which are particularly important in the control of paper, the standard surface used is magnesium oxide. For all ordinary work Illuminant A is employed, but Mr. Edge said that it was hoped soon to experiment with Illuminant B, and possibly C as well, using an attachment to increase the sensitivity of the instrument. He gave the results of a recent comparison between the values obtained for a number of samples by the use of the Blancometer and those calculated from data given by the Hardy recording spectrophotometer. The agreement was generally within the limits of accuracy claimed for the Blancometer.

The main use of the instrument as far as the paper-maker was concerned, said Mr. Edge, was the certainty with which it enabled him to reproduce the colour of any particular grade of paper, not only at any one time, but over an almost indefinite period. Even the best of papers showed slow changes of tint on keeping and in some cases, notably papers containing wood-pulp, the change was far from small. The instrument would not, however, indicate the amount of dye needed to make a given correction in tint, and in fact Mr. Edge said that he saw no likelihood of any colour-measuring instrument being able to help an experienced colour-matcher to this extent.

The chief use to which the instrument had been put as far as research was concerned was in the study of fading or discoloration of wood pulp sheets in light or heat or on long keeping. One interesting piece of work in which accurate colour measurement played an essential part was an investigation into the discoloration of certain azure papers in India, where the conditions of storage were bad, a combination of heat and high humidity. It was found possible to show which cases were due mainly to destruction of ultramarine and which to yellowing of the paper furnish. Mr. Edge concluded his paper with a mention of the ways in which experience had shown that the instrument could be improved.

The subsequent discussion was opened by Dr. Harrison, president of the technical section of the Paper Makers' Association, who asked whether the instrument would help in studying the problem of the two-sidedness of papers and whether it could be used to measure the colours of solutions. Mr. Edge said that the answer was "yes" to both questions. In reply to other speakers he said that the instrument would measure differences that were just detectable by the eye and that the state of the surface finish did not affect the results. Mr. Perry pointed out that the instrument was intended to measure differences and was not a colour-measuring instrument as that term was usually understood. Mr. Harding raised the question of the reproducibility of the instrument and the chairman (Mr. J. Guild) pointed out the need for constancy in the characteristics of the photo-cells. From the results Mr. Edge had quoted it appeared that the cells in his instrument were exceptionally stable.